III

STRATEGIC NUCLEAR WEAPONS AND MILITARY ENGINEERING, 1953-1960

The atmosphere of crisis and confrontation that has characterized much of Soviet-American relations since World War II took shape only gradually after 1945. As the Iron Curtain dropped in Europe and China fell to the communists, American leaders saw themselves faced increasingly with not only hostile but aggressive and expansionist enemies. The explosion of the first Russian nuclear device then shattered any American complacency based on its atomic monopoly. Just as the crises in Europe and the Far East had provided the impetus for the new mood of tension, the Soviet atomic bomb forced the United States to confront the frightening prospects of nuclear war and its own vulnerability to the new weapon. If the communist powers were bent on world conquest, then the logical course of action to many American leaders was a policy of "containment," preventing the spread of communism whenever and wherever it appeared: "It was relatively easy to visualize the Soviet Union as a major threat to the United States. It was more difficult to visualize what was demanded, particularly in the military field, to meet the threat. A foreign policy of containment implied that the aim of military strategy was to deter or to defeat Soviet aggressions. But what were the specific military requirements of such a policy?"[1] At just the time when American leaders were beginning to grapple with the military implications of containment, the first overt sign of the communist military challenge appeared in Korea.

The American response to the military aggression in Korea was straightforward and traditional, including the mobilization of manpower and resources, although not to the same degree as in World War II. The result, however, was not traditional. The drawnout, expensive, and frustrating war did not lead to a decisive conclusion, as had the victories in World Wars I and II. While the threat of communism in Korea seemed abundantly clear, the means of dealing with it were clouded in acrimony and debate. In this atmosphere, Dwight D. Eisenhower was elected President in 1952, pledging both to end the war in Korea and to contain communism.

While the Korean invasion seemed to confirm the threat of communism, the indecisive and costly war convinced the Eisenhower administration that conventional means of warfare modeled on the World War II experience were no longer appropriate. If the dangers of communist

expansion had to be confronted over the "long haul," then the military response to communism also had to be tailored for the indefinite future. Eisenhower believed that responding to each crisis in the fashion of Korea with heavy short-term military expenditures could seriously strain and dislocate the fundamental source of American strength—its enormous economic resources. The military budget needed to be kept moderate in order to avoid inflation and stable in order to face the long-term threat without seriously weakening the nation's economy. Thus while containment demanded constant military readiness, economy in military expenditures ruled out large conventional armed forces. The result of this "new look" of 1953 was the policy of "massive retaliation" announced in 1954.[2]

Although the first Russian nuclear test in 1949 had broken the American atomic monopoly, the United States appeared to have a comfortable superiority in delivery systems, which in the early 1950s meant medium- and long-range bombers. For the Eisenhower administration, the best response to Soviet aggression was prevention or deterrence. The destructive potential of atomic weapons certainly was horrible enough, but in 1952 this was multiplied a thousand-fold by the first explosion of a thermonuclear or hydrogen bomb. Now the various technical limitations on the size, number, and power of nuclear weapons vanished, and the United States could threaten and expect to deliver destruction of unmitigated horror. Nuclear war had become unthinkable unless communist aggressions were so blatant or unwarranted as to provoke massive retaliation and the wholesale destruction of the Soviet Union and China. The threat was deliberately or dangerously vague, depending on one's perspective, but it was meant to deter Soviet aggression by making the price unacceptably high.

The cost to the United States, however, would be relatively low in the long run. The principal instruments of massive retaliation would be the less expensive and more numerous thermonuclear weapons, and the principal military service would be the Air Force and its strategic bombers. The defense budget could then be both reduced and stabilized by deep and permanent reductions in the size of the Navy, and especially the Army, and the maintenance of the Air Force bombers in a high state of readiness. The policy of massive retaliation, therefore, satisfied the two requirements of the Eisenhower administration. It reduced the burden of the military budget on the economy, and it promised to deter communist aggression by threatening a swift, immediate, and effective American response.[3]

Not only did the Eisenhower defense policy substantially reduce military expenditures from their Korean War highs, it also drastically altered the allocation of that expenditure among the services. The American contribution to the defense of the "Free World" would come in the high technology fields of nuclear weapons, strategic bombers, and, by the late 1950s, guided missiles. Although all three services shared to some extent in

these weapons, the Air Force got the lion's share of the defense responsibilities and the defense budget as well. By the late 1950s the allocations had settled into a fairly consistent pattern with the Air Force receiving about 49 percent of the military budget, the Navy, 29 percent, and the Army, 22 percent. In addition, defense expenditures after Korea were generally kept within a ceiling, and thus each service had to live with a fairly constant budget allocation over a number of years.[4] It was almost a decade after the first atomic explosions before the armed services felt the full impact of the new nuclear era.

After the preeminent role it had played in World War II and Korea, it was the Army that suffered the greatest loss of status as the result of the new defense policy. The Army's share of the defense budget was cut in half from FY 1953 to FY 1956 and its manpower was reduced by one-third.[5] With the primary emphasis placed on strategic air power, defining exactly what role the Army and land forces would play in national defense became difficult. Although the advent of nuclear weapons clearly had altered the balance between the armed services, people both within and outside the Army criticized Eisenhower's heavy reliance on strategic nuclear weapons. Almost from its inception, academic strategists in universities and think tanks had argued that massive retaliation was too blunt and inflexible an instrument to be effective as a deterrent to all types of communist expansion. These civilian strategists along with prominent Army officers such as General Maxwell Taylor proposed a more balanced military establishment with conventional forces capable of thwarting aggressions short of a thermonuclear holocaust. Although military criticism of massive retaliation was muted during the early years of the Eisenhower administration, by the late 1950s Army officers would join other "defense intellectuals" in helping to shape the new Kennedy policy of "flexible response" that reduced American reliance on nuclear weapons and increased the role of conventional forces.[6]

Prior to President Kennedy's adoption of the flexible response position, however, the Army devoted a great deal of energy to carving out its own particular niche in the field of nuclear weapons and nuclear warfare. Although Eisenhower had given the Air Force the predominant role in strategic nuclear warfare, all three services would have a part to play in a total, general war. Thus all three had an interest in the plans for using strategic nuclear weapons. In addition, the Army had a particular interest in the new tactical nuclear weapons whose smaller yields and shorter ranges made them an important factor in any planning for land wars, particularly in Europe. If the future lay in atomic weapons, as seemed to be the case in the early 1950s, then it was natural that the Army had a direct interest in how they would be used and who would use them.[7] It was in the areas of strategic and tactical nuclear weapons that the Planning Studies Division (PSD) produced some of its most important studies of the Eisenhower era.

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Although PSD had begun doing some work in the nuclear field as early as 1950, it was only in 1954 that the organization became, as one retired analyst, John J. Taylor, put it, "the analytical arm for DCSOPS over in the Pentagon."[8] The basic planning for the use of nuclear weapons came from the Unified and Specified Commanders who would direct military operations in the event of a general war. Attached to the war plans of these commanders each year were the so-called "atomic annexes" in which the commanders indicated the targets for their nuclear strikes and the size of weapons. Each service then received and commented on the annexes. Within the Army, the Planning Studies Division became DCSOPS's "analytical arm" for studying the annexes.

Although nuclear weapons had existed since 1945, they were only slowly understood and integrated into military planning. In addition, any information on them was subject to stringent security restrictions. According to Major General David S. Parker, commander of PSD from 1957 to 1960, in the late 1950s "not very many people knew very much about atomic weapons:"[9] Reviewing the commanders' plans for using nuclear weapons, however, required both expertise and careful study, as General Parker indicated:

> In order to get some rational bases for requirements for atomic weapons and how they might be utilized, whoever worked on the problems had to have some math and analytical background. There was a shortage of what you might call math and analytical talent on the Army General Staff. Furthermore the Army staff—the average action officer on the Army staff—did not have time to do anything in depth. So there was an outstanding need for the Army staff to be able to get together a study group. They had to have someone to come up with answers to some of these planning problems.[10]

The prior work of PSD in the tactical nuclear field provided the expertise that was still lacking in much of the Army, and its position away from the daily and short-term pressures on the Army staff gave PSD analysts the time to study the complex questions of nuclear targeting: "There just was not any study group in Washington at that time available to the Army to do any of these studies. We filled a void, is what it amounted to."[11] Thus, during the Eisenhower years, the Planning Studies Division became the focal point for much of the Army's work on the use of strategic nuclear weapons.

In a short but closely argued study published in 1955, the division outlined the position that it, and to a large extent the Army, would take on the use of thermonuclear or "very high yield" (VHY) weapons until the closing months of the Eisenhower administration. Although thermonuclear weapons had an enormous and awesome potential for destruction, it was

imperative and "implicit to the execution of national policy" that they be used with restraint in order to avoid excessive devastation.[12] According to the study, the targets for VHY weapons should be restricted as much as possible to locations with a purely military significance, or in the parlance of a later period, "counterforce" targets: "Target location and weapons selection must be such as to minimize casualties among enemy personnel not directly associated with the operation of military, industrial, or transportation facilities essential to the support of the enemy military effort."[13] The Planning Studies Division's proposed "General Criteria for Selection of VHY Weapons" went on to stress the caveat that "destruction of cities primarily for the purpose of maximizing personnel casualties is prohibited."[14] A further measure of restraint was provided by the criterion that "weapons selected must be of the smallest yield available consistent with inflicting the desired degree of damage on the designated target."[15] And finally in what might seem like an obvious statement, the study warned that "weapons selection must provide a reasonable margin of safety for military and civilian populations of friendly and neutral countries."[16] Until the end of the 1950s, these remained the major criteria that PSD analysts used in evaluating the services' proposals for the use of strategic nuclear weapons.

Although the Unified and Specified Commanders drew up the "atomic annexes," the Joint Chiefs of staff (JCS) provided guidance for constructing these nuclear strike plans. According to the guidance of the mid-1950s, the objectives of an American atomic offensive would be

> 1. To neutralize the enemy's capability to conduct an atomic attack,
> 2. To retard or halt the movement of enemy military forces into allied territory, and
> 3. To destroy enemy industries and resources that would contribute directly to initial military operations.[17]

While substantial numbers of nuclear weapons were allocated to Unified Commanders, such as the Commander in Chief of American forces in Europe (CINCEUR) and the Commander in Chief of American forces in the Pacific (CINCPAC), the largest responsibility for conducting strategic nuclear warfare fell to the Commander in Chief of the Strategic Air Command (CINCSAC). Although the guidance changed slightly from year to year, largely in order to make it less vague and less complicated, the PSD studies of the nuclear war plans disclosed that strict adherence to the guidance was not usually the rule.

One of the most serious problems revealed was potential overdestruction, which in essence meant that too many weapons, often with excessive yield, were programmed on individual targets. Moreover, some targets were scheduled for surface bursts that would create the maximum

possible destruction and fallout, although these targets were not always of sufficient military value to justify the risks involved in such heavy attacks (see figure 12). On many targets, a small yield airburst weapon could achieve sufficient destruction and avoid creating another major problem—radioactive fallout.

Although the JCS guidance called for as little destruction of civilian population as possible, numerous surface-burst thermonuclear weapons would necessarily create huge clouds of radioactivity and thousands, if not millions, of casualties. Policy guidance at that time stated that attacks on enemy urban areas solely for the destruction of enemy population should not be programmed. However, fallout casualties would have been inflicted on urban areas from surface-burst weapons detonated on targets located upwind of major cities.

The problems of overbombing stemmed from insufficient coordination between commands, causing much duplication for no apparent military reasons. Not only did excessive duplication waste weapons and delivery systems, but it also could have led to an unbalanced stockpile of atomic weapons and an unbalanced force structure with more weapons and aircraft than were needed.[18] The lack of coordination, then, was another major problem.

PSD's last comprehensive study of the annexes concluded with a briefing before the Joint staff in March 1959.[19] This briefing detailed problem areas in the entire nuclear war planning process. With the policy guidance itself unclear and the annexes so full of either violations or misunderstandings of that guidance, determining how effective the plans would be in a wartime situation was difficult: "A detailed review of the annexes leaves the impression that the annexes are somewhat divorced from reality and represent a system of accounting for or justifying allocated weapons, rather than an estimate of capabilities."[20]

These were blunt conclusions to send to the Joint staff, but in August 1959 the Army staff asked PSD to present its analysis of the annexes to the Joint Chiefs of Staff in person. Although both of the analysts who were present at the briefing had vivid memories of the day, the man who conducted the briefing, General Parker, gave the most detailed account:

> We worked on these [annexes] for a couple of years and finally it culminated in the presentation we made, Jerry Taylor and I made, to the Chairman of the Joint Chiefs of Staff, in August 1959. I think this probably, certainly within my experience, was the most important presentation we ever made, because we had done a very thorough review of the atomic annexes submitted by the Commanders. There was a lot of overlapping and duplication. Some of the plans could conceivably have been injurious to our own troops. We used material that the Air Force itself had generated, so our sources were quite authentic. When we presented this to the Joint Chiefs of Staff, I might say that it

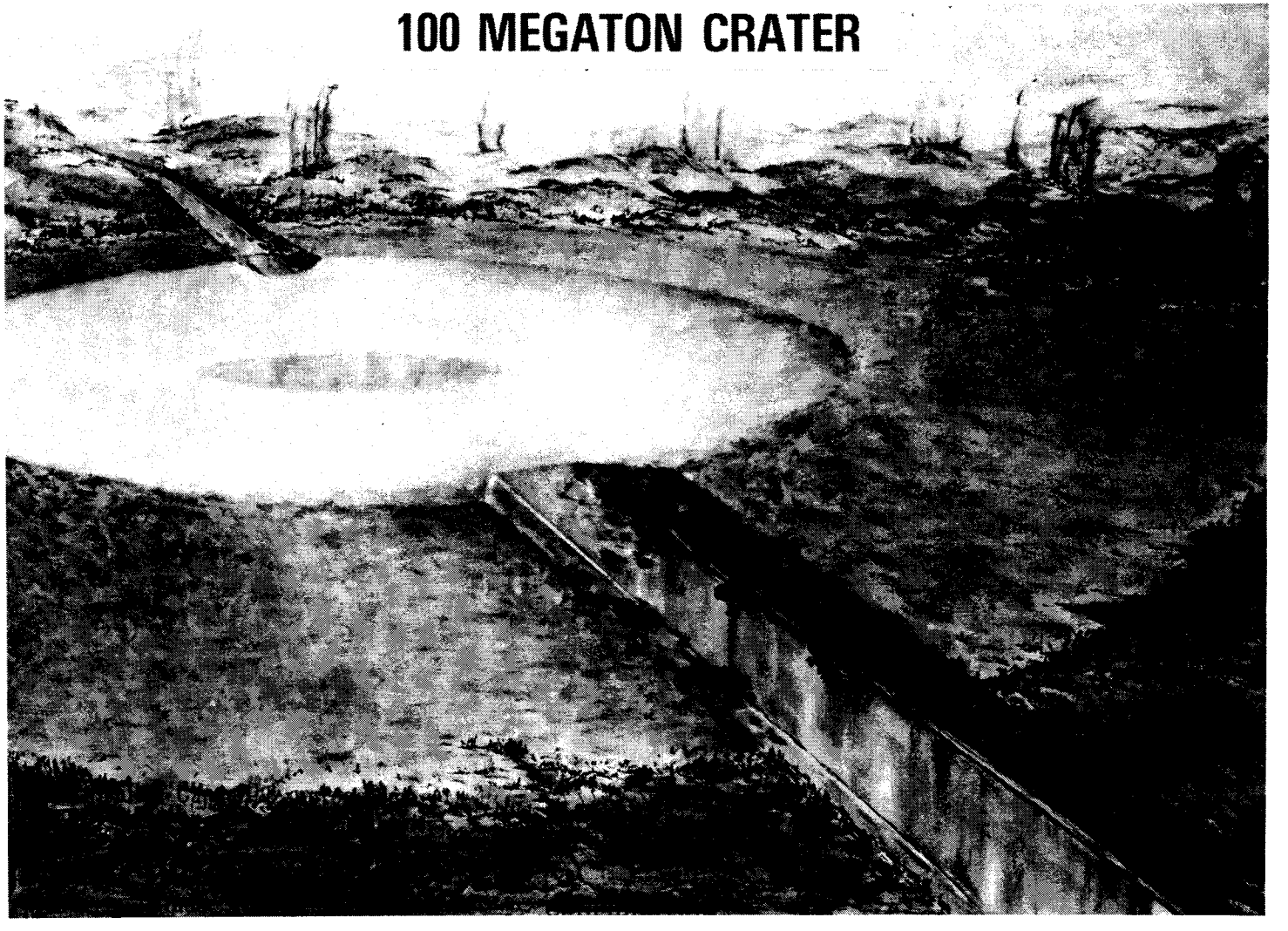

Figure 12

> was almost like a bombshell. General Lemnitzer, who was then the Army Chief of Staff, asked us to bring it into the Joint Chiefs of Staff. The material that we put on the briefing boards was of such a nature that when it was completed, there was absolute dead silence in the room. They just could not believe it and the first thing was Admiral Burke saying "Jesus Christ" after about a few seconds had gone by. Then General Twining, who was Chairman, got very mad, very upset because in some respect this was rather critical of the Air Force more than anyone else. He turned to me and said he did not believe the briefing and was sure it was incorrect and he was going to turn it over to the Air Staff for review. That was the way it ended. Jerry and I then went back to the office to figure out if we had anything wrong, to see if there was anything possibly wrong in it, and we could not find anything. No critical comment was ever made of the presentation.[21]

Although other factors were involved, both Mr. Taylor and General Parker considered the presentation a major cause for changing the nuclear targeting procedures:

> And as a result, maybe not just from our briefing, but of other actions going on at the time, they formed the Joint Strategic Target Planning Staff out at Omaha at SAC headquarters, the JSTPS. For the first time SAC alone did not write the nuclear weapons plans, but it was joint participation with both the Navy and the Army and the Marine Corps. And that staff still exists and that is the prime reason for its being—just to draw up the Single Integrated Operations Plan which they call SIOP. I believe that in large measure we were responsible for this.[22]

Since 1960 the JSTPS, and not the Unified and Specified Commanders, has been responsible for drawing up a single and integrated plan for utilizing nuclear weapons in the case of war.[23] Although nuclear targeting policy has changed several times since 1960, PSD was at least partially responsible for the formation of a central military planning agency for this purpose.

In its five years of analyzing the atomic annexes, PSD also discovered other problems, some more subtle and far reaching than the lack of coordination among the commanders. The 1950s saw two major technological innovations in strategic weapons, the advent of the thermonuclear weapon and the intercontinental ballistic missile (ICBM), whose implications were only gradually understood and integrated into national defense planning. In its first major study of thermonuclear weapons in 1955, the division singled out what it saw as the most critical area: "The most important and far reaching effect of a VHY surface burst weapon is contamination with radioactive fall-out material of large areas at a considerable distance downwind from the point of detonation."[24] In the mid-1950s, the effects of fallout were not always well understood or considered fully in military planning.

Although PSD did not do the technical work on the physiological effects of radioactivity, it did begin to examine the information about these effects more carefully. Scientists had known about the dangers of fallout since the first atomic explosions in 1945, but its far-reaching significance was only slowly understood: "At that time people were saying you could take 250 roentgens and have only a 50 percent chance of sickness. No one was looking beyond that to the genetic effects or even the physiological effects that are showing up now in a lot of people who participated in the tests."[25] In 1954, however, PSD did a study of an early hydrogen bomb explosion and in the words of Colonel Warren S. Everett, the commander of the organization from 1955 to 1956, "We were appalled at the implications of the massive fallout generated by thermonuclear devices. The further we dug into it, the more appalled we became."[26] The PSD studies from 1955 to 1960, particularly those of atomic annexes, showed a growing concern with the role of fallout and contained persistent criticism of the Unified and Specified Commanders for their failure either to consider or to acknowledge the role that fallout played in their war plans.

One of the first and obviously significant problems that PSD encountered was the possible effects that fallout from the commanders' planned attacks could have on friendly and neutral nations and on friendly armed forces. The analysis of fallout patterns was difficult because it depended on wind conditions at the time of the attack. In several studies PSD examined wind and climate data in an attempt to establish estimates of probable wind conditions or, if that was impossible, the best and worst possible wind conditions in any particular area according to season. The results of even these simplified studies surprised the analysts, including Mr. Taylor:

> We began to look at the residual radiation effects for a lot of the surface bursts, drawing on climatological data for historical wind patterns to see if we could get some idea of the probability of fallout contamination. There was a chance of serious contamination of our own forces in Europe under certain wind conditions. So this led to a study we did, that was later adopted, in which we introduced operational constraints to control the radiological hazard. In other words, we picked points along the periphery, friendly areas where we said under the planned employment of strike plans, there should be at least a 90 percent assurance that a dose no greater than 100 roentgens would fall on this area—this type of thing. These constraints, as I understand it, still exist in much of the planning.[27]

In fact the analyses of the atomic annexes after the 1956 study showed that the problem of the unintentional contamination of friendly forces declined markedly.

PSD also had an opportunity on at least one occasion to comment on the fallout predictions of an official more highly placed than the military

commanders. During one of the periodic crises in the mid-1950s over the Nationalist-Chinese-held islands of Quemoy and Matsu, close to the Chinese mainland, Secretary of State John Foster Dulles alluded to the use of nuclear weapons, and Mr. Taylor recalled that PSD examined the Secretary's statements:

> We did a little quick study designed to refute Secretary Dulles' statement that we could use these weapons on the offshore islands and on air bases in China with minimal side effects on the civilian population. We took the smallest yields that we had in our arsenal at that time and the most accurate aircraft delivery systems and found that even with this combination, the casualties that would be inflicted on the Chinese population would be very high. What Mr. Dulles said was not true. There was no way we could use those weapons at that time without causing hundreds of thousands of injuries to the Chinese population. [The study] went up to the highest echelons of the Army and Joint Staff at the Pentagon.[28]

The consequences of using nuclear weapons were not well understood at many levels of government in the mid-1950s.

While the unintended or unexpected consequences of radioactive fallout may have been primarily a technical problem, the intended and expected consequences of fallout were a much more sensitive problem of national military policy. The enormous clouds of radioactive material from hundreds of surface-burst multi-megaton thermonuclear explosions had the capacity to kill millions of human beings. That fact was irrefutable. The question, however, was whether or not creating this fallout hazard was our military policy. The JCS guidance for the atomic annexes directed nuclear attacks against military targets—atomic weapons and their delivery vehicles, military and naval facilities and manpower, and war-related industries. Policy further called for airbursts and the smallest possible weapon appropriate to the intended target—both of which would minimize fallout. Finally, the guidance forbade attack on the civilian population of cities as a primary objective of targeting.

Yet throughout its analysis of the atomic annexes, PSD found little explicit attention devoted to the consequences of fallout: "Department of the Army review of the Atomic Annexes indicated that Commanders do not realize the tremendous civilian destruction caused by their attacks."[29] In spite of the growing understanding of fallout, its role in the attack remained ambiguous: "In recent years it has become increasingly evident that the tremendous damage and killing power from radiological contamination achieved by massive use of TN [thermonuclear] surface burst weapons cannot be ignored. Most damage analysis systems disregard this phenomenon by treating it as a bonus effect."[30]

In April 1957, PSD published a study in which it explicitly examined "residual radiation as a primary means of deterring general war."[31] In this

study, fallout was considered as a "primary" effect rather than a "bonus effect." The study compared two types of attacks: a neutralization or counterforce attack against atomic delivery and counter-air capability and a denial attack with radioactivity as the primary effect. It was in this comparison that the accuracy of delivery systems—aircraft versus missiles—became an important factor of consideration: "Delivery errors as currently available or forecast for aircraft and missile delivery systems are of negligible importance in a radiation denial attack, but are of major importance in a neutralization attack where blast or cratering must be utilized to achieve immediate destruction of high priority hardened targets."[32] With the presumed growth of the Soviet air defense system, aircraft could no longer be assumed to have "a high assurance of quick penetration through air defenses to the target,"[33] while missiles, which were estimated to be quite inaccurate, could not achieve the combination of low yield and high accuracy that would destroy the target by blast or cratering while minimizing radioactivity.[34] The 1957 study stated these problems without much further analysis and concluded by returning to a theme that appeared in all the analyses of the atomic annexes: "The [denial] attacks described in this study, if carried to completion, would achieve results staggering in magnitude by virtually accomplishing genocide on a major world power with a population of 200,000,000 plus destroying most of the industrial population and potential of China."[35]

In November of 1958, PSD prepared another briefing in which it faced the challenges to the counterforce targeting system more directly: "During the past year, considerable attention has been given to the possibility of discarding at least part of a military and individual industrial target system."[36] The study cited several important factors that led to the reappraisal of targeting concepts. The first was "the fact that our requirements against a military and individual industrial target system are seemingly endless."[37] As evidence of this endless process, PSD cited SAC's projected nuclear weapons requirements, which more than quadrupled between 1958 and 1959 and were expected to increase more than sixfold between 1958 and 1960. Second was "the recognition that the current target system, although ostensibly aimed at military and critical industrial targets, constitutes, in fact, an attack on population centers."[38] Again PSD returned to one of the themes in its critique of the atomic annexes. Third, the study explicitly assumed that the United States would be hit first by a Soviet nuclear attack and, under those conditions, it would be too late to attempt to eliminate every element of the enemy's strategic atomic capacity. Furthermore, the American strategic forces remaining after a first strike would not be able to strike a very large target system in the Soviet Union.[39] These considerations alone might well have cast considerable doubt on the viability of the counterforce doctrine, but other factors also affected PSD's reexamination of these problems.

One of the key factors was the integration of the new ICBM into the calculations about the means of delivering an atomic attack. Even before the launching of Sputnik in 1957 fired the public imagination, the military was already facing the problems of determining the roles of the first primitive ICBMs and the next, more sophisticated, generation of missiles. The role of the ICBMs was a subject of controversy because of the Air Force's continuing commitment to manned bombers, but as General Parker recalled, PSD had already embraced the missile age: "You have to remember in the late fifties the major threat was still aircraft. We could see that this was going to shift to a missile threat."[40] Based on evidence that the Soviets had increased their air defense measures, which would increase the difficulty of bombers reaching their targets, PSD concluded that "aircraft are required in 1965 only for the attack of airfields. If these airfield targets do not exist, there is no requirement for aircraft."[41] In fact PSD was predicting the end of manned bombers:

> With respect to manned aircraft for the short-range period, although analysis indicates that we have more strategic aircraft than we require, particularly compared to our deficiencies in other forces, it is not suggested that we scrap large numbers of existing suitable aircraft; however, it is proposed that bomber force levels be phased down by normal wear-out and attrition.[42]

The strategic weapon of the future then would be the ICBM.

Yet this new weapon had its own technical problems and difficulties that had to be considered, as General Parker explained:

> In the late fifties there were several uncertainties. One of them was how accurate missiles could ever be because of geodetic and other problems. We did not have accurate measurements on the shape of the earth and we did not know whether you could locate the targets accurately or not. You were talking about probable errors in finding the target of a considerable distance, a mile or more.[43]

In addition, missile guidance systems were inertial, which also decreased accuracy. Thus, while missiles were relatively sure of penetrating Soviet air defenses, they did not have the accuracy that was theoretically possible with manned bombers.

Another problem that affected the counterforce doctrine was locating Soviet missile sites. In a 1960 study, PSD stated that no accurate estimates of projected Soviet missile force levels existed, and even if the force levels were known, there was no assurance that the sites could be located. This difficulty would be exacerbated if the Soviet missiles were mobile.[44]

Even if the enemy missile sites were fixed, however, substantial problems remained. The early ICBMs, which were located above ground and fueled by highly volatile liquid propellants, were very vulnerable to attack.

The second generation of missiles was to be propelled by more stable, solid fuels and sunk into below-ground, hardened silos that could resist the blast of anything but a nearly direct hit by a nuclear weapon. That these missile sites would be widely dispersed was also expected. Whether mobile or fixed and hardened, the problems of locating the sites and then hitting them with relatively inaccurate missiles seemed in 1960 to create almost insurmountable obstacles to the continued adherence to a counterforce strategy.

According to PSD, continuing to follow the counterforce tenets of American strategic doctrine would result in the "endless" requirement for ICBMs that it referred to in 1958:

> Even assuming major improvement in our own geodesy, missile capabilities and intelligence, it would take from 5 to 10 U.S. missiles in inventory in 1963 to neutralize a reasonably hardened Soviet ICBM site. Are we prepared to build 5 to 10 missiles for each hardened Soviet missile in the hope we can find it, locate it accurately, and in retaliation, somehow destroy it before it launches?[45]

As the Soviet missile force grew, then the SAC force, programmed to attack all the sites as well as many other targets, would have to grow exponentially. And the arms race would spiral ever upward.

The PSD study published in 1960 and entitled the "ICBM Duel" was, according to General Parker, one of the first studies of its kind.[46] "We could not find anything on what happened in a missile exchange," and thus the division initiated a "very brief, non-detailed study just to get something started."[47] The conclusions of this study, which brought together a long period of PSD thinking, were bluntly stated: "Looking back over the entire analysis, there is really only one major conclusion to the briefing: unless we can shoot at soft, located, fixed sites it does not appear to be feasible to attack ICBMs with ICBMs."[48] Because "soft, located, fixed sites" were precisely *not* what was projected for the future, then the problem was fundamental: "We could also state that it is essential that the United States establish the role of its ICBMs. If they can't be used against enemy ICBMs, then we must determine how we are going to use them."[49]

The process of evolution that PSD analysis experienced and the conclusions it reached were succinctly summarized in a related paper prepared by John J. Taylor, the leading PSD analyst in the nuclear field:

> All too frequently, general war deterrence and the capability to prevail are measured in terms of our offensive capabilities alone. Since our national security policy envisages our striking in retaliation, it is apparent that our offensive forces cannot mitigate the initial blow against CONUS [Continental United States]; our active and passive defenses must be developed to permit us to survive the initial blow and to retain residual capabilities which will permit us to prevail.

> The second point has to do with the increasing difficulty of executing a strategic counterforce role, particularly in retaliation. This is an extremely serious dilemma, since lack of a counterforce capability paves the way for political blackmail. Nevertheless, our strategic plans and concepts must be geared to reality; proposals for weapons and forces designed for a counterforce role must be very carefully weighed and tested for feasibility before committing resources to their development and build-up.
>
> It has been argued by some that it is possible to attack a purely military strategic target system with only limited casualties and suffering for the civilian population. However, even several years ago when our delivery systems were more reliable and precise, the Army pointed out that the attack of military targets as proposed by the Unified and Specified Commanders would result in very high civilian casualty levels. Army efforts in the past were directed toward improving the targeting and damage criteria concepts so as to permit application of measured military force compatible with the preservation of civilian social fabric. However, with the passage of time, it has become increasingly apparent that our so-called "military" attacks have become so interwoven with civilian targets as to make a strategic military target system almost indistinguishable in results from one aimed directly at population centers. Accordingly, the Army believes that we should abandon our pretense of "military" targeting and should state our objectives realistically.
>
> By contrast with counterforce target problems, most current strategic targeting studies show that enemy population and economic resource targets are relatively few and relatively easy to attack. The number of such targets necessary for effective deterrence will always be conjectural and will be subject to revision if the enemy hardens his population and industry. However, most studies in this field regardless of source or service, indicate that the successful attack of a limited number of enemy population centers results in such high damage levels that the capability to attack this limited system would appear to act as a strong deterrent to initiation of general war by any rational government.[50]

What Mr. Taylor has described is a part of the process that led to the adoption of the counter-city or countervalue nuclear strategy in the 1960s—the strategy of mutual assured destruction, first announced by Secretary of Defense Robert McNamara and the official American nuclear strategic position until the late 1970s. Although McNamara only gradually and hesitantly formulated this doctrine as official American policy in the early 1960s, a prototype of the strategy appeared in PSD studies as early as 1957 and 1958, and Mr. Taylor's statement in 1960 was a brief, cogent, if somewhat resigned, argument for its adoption. As Mr. Taylor indicated, PSD did not originate this strategy and in fact resisted its implications but

gradually, because of technological and strategic factors, accepted it as the only realistic alternative. As General Parker phrased it, "we were in on the birth of the nuclear strategy that the United States used for some number of years."[51]

PSD did not confine its studies of the early ICBMs to targeting problems alone. In the late 1950s, the Defense Department was drawing up plans for the deployment of the second generation of American missiles, the Minuteman, and even at this early date questions were raised about the most effective method for basing the missiles. In March 1960 the division published a study entitled "Project Iceworm," which proposed an alternative to basing the Minuteman in hardened silos within the United States.[52] Project Iceworm would base the new missiles in a network of tunnels dug in the Greenland icecap, and in many respects the system resembled the mobile MX system advanced by the Carter administration almost two decades later.

In the introduction to the study, PSD summarized the salient features of Project Iceworm:

> The missile force is hidden and elusive. It is deployed into an extensive cut-and-cover tunnel network in which men and missiles are protected from weather and to a degree, from enemy attack. The deployment is invulnerable to all but massive attacks and even then most of the force can be launched. Concealment and variability of the deployment pattern are exploited to prevent the enemy from targeting the critical elements of the force.[53]

Using existing technology, American forces would dig a series of ditches in the icecap, place prefabricated galleries in these ditches, and cover them with ice and snow, making them virtually impossible to detect. The complex of tunnels, command and control facilities, and launching sites would cover an area the size of Alabama, and the launch sites would be located several miles from each other, so that a nuclear detonation on one site would leave the others unharmed (see figure 13). Because the tunnels would be relatively easy to dig, the men assigned to garrison the system could expand the network, adding to the number of launch sites. Although the division acknowledged that the tunnels would be "softer" than the hardened silos of the Minuteman system, this disadvantage and the increased cost of Project Iceworm over Minuteman would be more than compensated for by the advantages of Iceworm.

The Iceworm missile, called Iceman, would be located closer to enemy targets than Minuteman, and thus the proposed Iceman missile could have two stages rather than three and still arrive at its target in substantially less time and with greater accuracy than the Minuteman (see figure 14). Iceman could also be reached more quickly by Soviet strategic and even tactical forces, but PSD felt that the hostile Arctic environment and the concealment of the missiles over a vast space would cancel out this liability.[54]

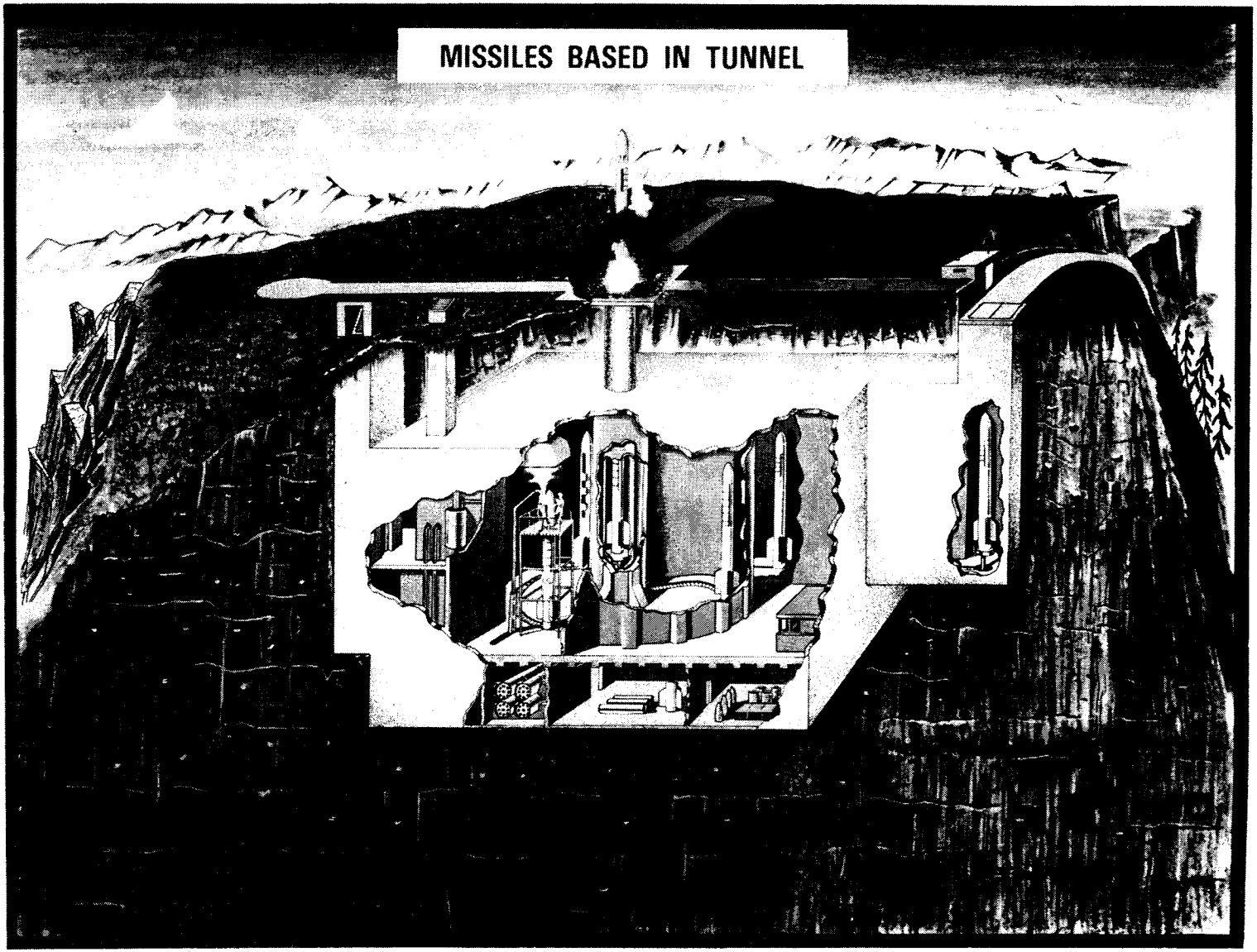

Figure 13

DISTANCE RELATIONSHIPS FROM CONUS AND GREENLAND

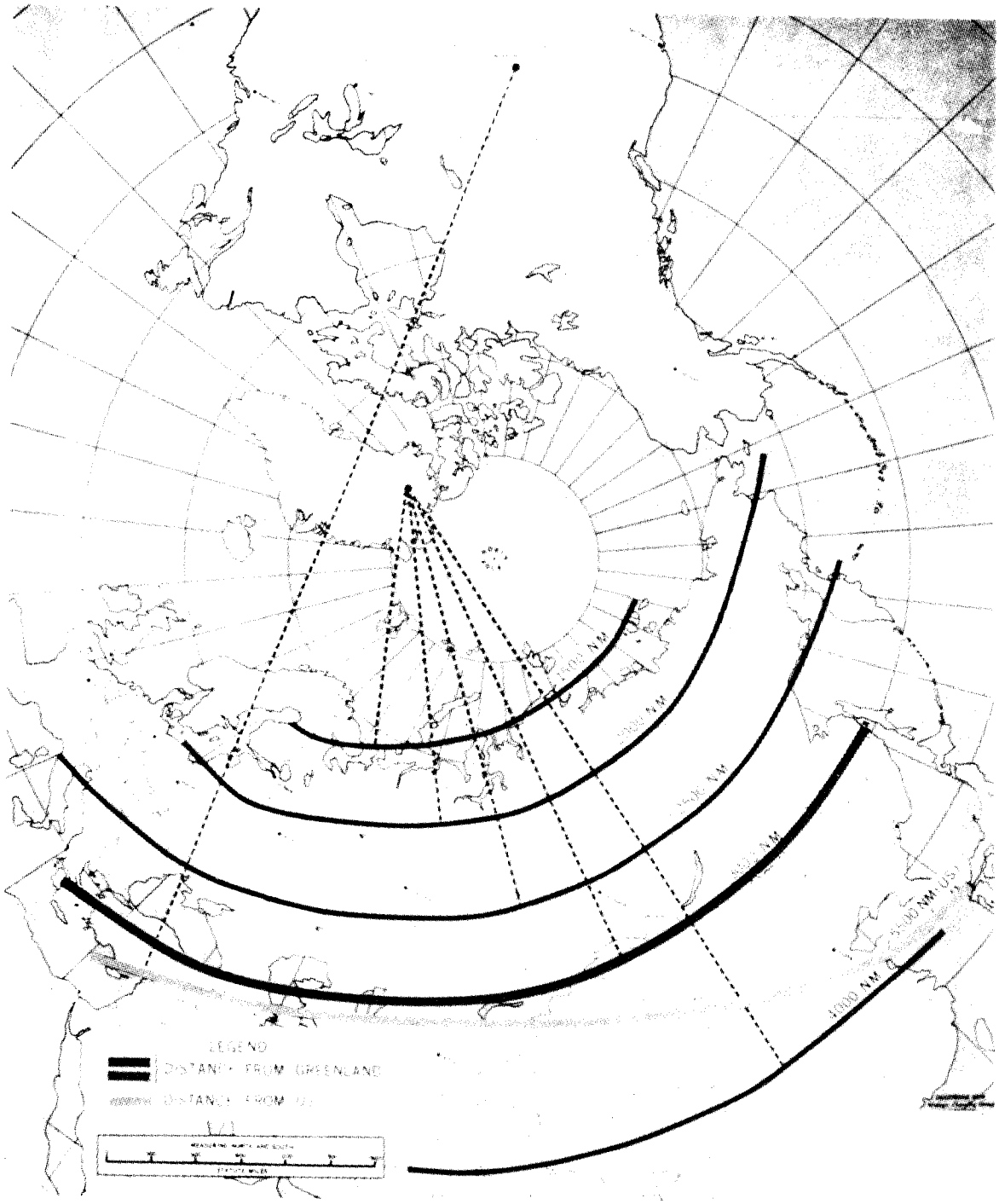

Figure 14

The greatest advantage of Iceworm, however, was that it was "hidden and elusive." "The critical elements of the force are movable and will be periodically and randomly redeployed to alternate and new positions. The continuous movement keeps the pattern of deployment quite variable and relatively difficult to target."[55] Athough the system might be vulnerable to a massive "carpet bombing" by thousands of thermonuclear weapons or an attack by airborne ground forces, neither attack would prevent the launching of a substantial portion of the Iceworm force.[56] PSD also noted that although hardened silos were relatively safe from attack by ICBMs with the accuracy of 1960 missiles, missile accuracy was likely to improve and thus the proposed Minuteman silos in the United States "may have but limited useful lives."[57] Located in a barren wilderness far from American population centers, Iceworm would probably remain "relatively invulnerable" for years.

Although the Iceworm proposal had a number of problems, not the least of which was the fact that Greenland belonged to a foreign country, it was an imaginative and prophetic attempt to anticipate and deal with the difficulties brought on by the missile age. Beginning with its studies of the atomic annexes, PSD struggled to understand and integrate the new and often ill-defined factors of nuclear and missile technology. In its attempts to hold the Unified and Specified Commanders to the JCS guidance, PSD pointed out the increasingly difficult problems of reconciling a counterforce strategy with the massive destructiveness of thermonuclear weapons and the decreasing accuracy of delivery systems. If the logic of the future dictated reliance on missiles, then counterforce implied an ever-expanding American nuclear arsenal that, if launched, would have the effect of a countervalue strike no matter what its original purpose. This dilemma pushed PSD toward the strategy that would later be called mutual assured destruction—a strategy that would require a limited and controllable number of delivery systems and would provide a military purpose for all the effects of nuclear weapons. In its studies of strategic nuclear warfare, including Project Iceworm, PSD operated on the frontiers of the new nuclear, missile age and anticipated many of the problems of nuclear warfare that would confront the United States over the next two decades.

* * *

While PSD's work in strategic nuclear warfare seemed somewhat beyond the bounds of what might have been expected from a study organization in the Army Corps of Engineers, its work in the field of tactical nuclear warfare was more in keeping with the preoccupation of the Army during the Eisenhower era. During the seminal period in the early 1950s when major technological breakthroughs resulted in the hydrogen

bomb and the more efficient use of fissionable materials, new developments also made tactical nuclear weapons possible. These "tactical" weapons were much smaller and lighter than the early atomic bombs, and their yields were in the lower kiloton range as opposed to the megatons of the new hydrogen bomb. It was therefore possible to mount them on short- and medium-range missiles or fire them from artillery pieces without as much danger that massive explosions or enormous fallout would destroy our own troops. In short, it would be possible to use them tactically on the battlefield where the Army would still have a major role to play.

The use of tactical nuclear weapons, as with strategic ones, was embraced by the Eisenhower administration and for many of the same reasons. Both types of weapons were relatively cheap compared to other defense costs, and both served the cause of deterrence. In addition, tactical nuclear weapons supplemented strategic weapons. Strategic weapons made deep reductions in conventional forces possible, but these reductions, particularly in manpower, could be at least partially offset by the tactical nuclear weapons that increased enormously the firepower of the remaining land forces. In October 1954 the Eisenhower administration announced that tactical nuclear weapons would be routinely assigned to American troops and that they were authorized to use them. Or to paraphrase Secretary Dulles, nuclear weapons were to be considered conventional, and America's enemies were given due notice of that fact. In 1953 the first tactical nuclear weapons were stationed in Europe and by the mid-1950s there were several thousand of them, primarily under the control of the Army. Technology had made these new weapons possible, but the problems of how to use them remained to be solved.[58]

In the 1950s the Army made a concerted effort to identify and adapt to the requirements of tactical nuclear warfare. Through numerous studies and war games, the Army sought new principles of doctrine and organization that would allow forces to operate effectively in the radically different environment of the atomic battlefield.[59] The division participated in this effort by producing a variety of studies of tactical nuclear warfare, and several of the themes that appeared in PSD's analysis of strategic nuclear warfare also appeared in these studies. In an early study of the weapon requirements for tactical nuclear war, PSD posited, for the sake of analysis, a type of "unrestricted" battlefield nuclear war in which both sides would attack military and civilian targets without any restraints on weapon yields or target characteristics. The enormous destruction and virtually endless weapons requirements produced by this unrestricted warfare led PSD to conclude that "deliberate consideration of this concept has failed to develop any logical means by which sustained ground or air operations would be possible."[60] Only the assumption of "restricted" warfare in which the targets were purely military seemed to allow one to estimate reasonable requirements for atomic weapons.

Using the assumption of restricted warfare, PSD evaluated a tactical nuclear war game, Exercise SAGEBRUSH, conducted in 1955, and uncovered a variety of problems. The analysis of SAGEBRUSH, like that of the atomic annexes, revealed that "there was an apparent lack of appreciation of the military implication of atomic weapons effects among commanders and their staffs."[61] The use of high-yield explosions not only threatened friendly troops with exposure to fallout, but also created substantial physical obstacles to their advance over the battlefield. Although the study recognized that tactical nuclear strikes would require close coordination between Army commanders and the Air Force, the time required in the exercise to locate and then strike enemy targets was so long that the division felt that most targets would be lost. In addition, the PSD concluded that American troop concentrations were still dense enough to be highly vulnerable to enemy nuclear strikes even though the Army had already adopted more widely dispersed formations than those used in World War II.[62] These and other problems led PSD to conclude that "it is improbable that the Army could continue to operate effectively in an atomic war over an extended period of time with the organization, equipment, and techniques employed in this exercise."[63] Not only was PSD willing to criticize the Air Force, as it had done in the studies of the atomic annexes, but it was also willing to criticize, in rather blunt terms, the Army itself. And this criticism had an impact. In a Foreword attached to the SAGEBRUSH study, General Maxwell Taylor, then Army Chief of Staff, endorsed most of the study's conclusions and called for specific changes in order to improve the Army's ability to wage tactical nuclear war.[64]

In the late 1950s PSD also developed several of the Army's projections of requirements for medium- and short-range missiles and their nuclear warheads. Based on its analysis of the nature of tactical nuclear warfare, PSD estimated the number and types of missiles that would be needed and the sizes of the warheads. Throughout these studies, the division called for the development and use of the smallest effective nuclear warheads in order to minimize fallout and overdestruction. The studies calculated the missile requirements for specific theaters and at times involved rather detailed analysis of the logistical feasibility of using specific missiles in certain geographic regions.[65] In these studies PSD used its expertise in nuclear weapons and their delivery systems along with its engineering and logistical knowledge.

In 1959 PSD published two studies on missiles that the commander during that period, General Parker, singled out as examples of "what capable young officers can do when they have the proper math and analytical background."[66] Both of these studies were early attempts to find alternatives to the highly vulnerable, fixed missile sites in Europe.[67] Using the principles of mobility and concealment that PSD applied later to strategic missiles in Project Iceworm, the studies proposed that the tactical

missiles and their launching equipment be placed on railroad cars or barges in the European network of rivers and canals (see figure 15). Disguised to resemble normal traffic, the trains or barges would move constantly to avoid detection and targeting, and the launch sites along the tracks or waterways would be too numerous for an enemy to target effectively. Although neither study went into great detail, they both proposed solutions to technical problems, such as the instability of a railroad car or a barge as a launching platform; and military problems, such as the vulnerability of railroads and canals to sabotage. While both may have been "prefeasibility" studies, they demonstrated PSD's early awareness of the potential military problems of the new missile age.

In addition to studies of missiles and warheads, the division worked on another category of nuclear weapons—atomic demolition munitions (ADMs).[68] The ADM is a small nuclear device that can be transported easily, emplaced by hand, and detonated by remote control. Like the other tactical nuclear weapons, ADMs entered the American nuclear arsenal in the early 1950s, and their most obvious usefulness lay in the Engineer barrier and denial operations that the Strategic Planning Section and Major Rebh had developed after 1950. While barrier and denial plans called for the use of aircraft- and missile-delivered atomic weapons as well, the ADMs' role was primarily to supplement or supersede conventional explosives when the potential targets were too large or too difficult to destroy with nonnuclear weapons. From the beginnings of its ADM studies, the PSD was aware of both the advantages and limitations of the new device.[69] Because the weapon was emplaced by hand, it had no delivery error and thus its effects could be calculated very precisely, avoiding overdestruction and unnecessary civilian or friendly military casualties. In addition, it was reliable, inexpensive, and easily transportable. On the other hand, the first ADMs, like other early tactical nuclear weapons, had large yields, and because they could only be detonated on or under the ground, they produced large amounts of fallout that limited their use in populated areas.[70]

Given these characteristics, the first PSD studies of ADMs limited their employment to targets that were large, difficult to destroy with conventional explosives, and located in sparsely populated areas. Appropriate denial targets, then, were tunnels, airfields that required extensive runway cratering, and underground installations such as petroleum storage or command facilities, while the primary barrier targets were defiles that provided for passage through rough terrain and could be easily blocked by craters or landslides. Although other targets such as bridges, dams, or ports could be destroyed by ADMs, their location in urban areas or the ease with which they could be destroyed by conventional explosives made nuclear weapons inappropriate or unnecessary.[71]

By 1958, however, PSD recommended expanding the use of ADMs. In the two years since the 1956 study, smaller munitions in the fractional

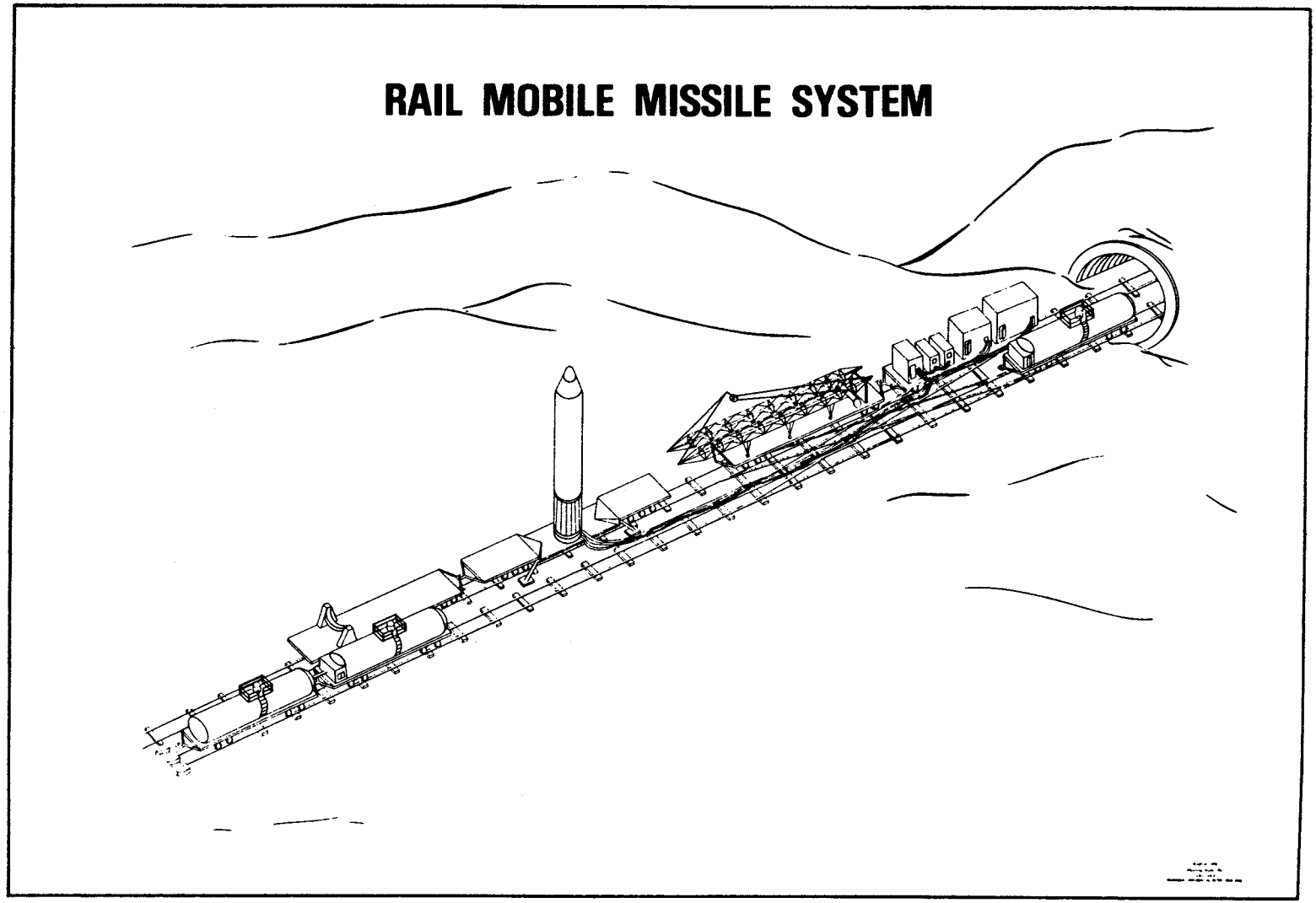

Figure 15

kiloton range had become available, and with "the advent of the era of atomic plenty,"[72] these smaller devices could be used more freely and with greater safety from unintended fallout damage. To the previous list of recommended targets PSD added more large bridges that could be destroyed with less time and effort than was possible with conventional explosives and it included large numbers of road craters that had been virtually impossible to produce in effective size and depth with older explosives. In spite of this expanded usage, the division remained very much aware of the problems associated with ADMs, especially the fallout damage that even the fractional kiloton devices could cause in a heavily populated area like Western Europe.[73] ADMs could solve some problems in barrier and denial planning, but they were not panaceas.

By 1958 the Planning Studies Division had almost a decade of experience in drawing up barrier and denial plans, and in that year it pulled together its own experience and current Army doctrine in a broad study of the *General Concepts of Engineer Barrier and Denial Planning*. The study reiterated the fundamental rationale behind this type of planning: "In view of the initial superiority in strength of Soviet Bloc troops over Allied troop strength, advantage must be taken of the great industrial capacity of the free world to narrow this gap by developing an effective combat superiority with fewer troops. Effective barrier systems provide one such means."[74] While barrier plans made use of physical terrain features, they strengthened the natural features by employing not only ADMs but also thousands of antitank and antipersonnel mines and hundreds of miles of wire obstacles (see figure 16). The study classified terrain into four rough categories and then laid out in detail the requirements in materiel and manpower to provide effective barriers across each type of terrain. In its discussion of denial plans, PSD not only outlined likely targets for massive ADM destruction, but also specified the small "critical elements" in various types of installations that could be destroyed with less effort and still render the entire installation inoperative. In the tables that accompany the discussion, PSD listed the vulnerable elements of denial targets, such as power plants, railroad yards, and telecommunications systems, and described exactly what was required to destroy them.[75] The 1958 study was both a planning tool and a textbook on barrier and denial operations.

Later in 1959, however, the division took a somewhat more critical look at the development of Army doctrine and expectations of barrier planning. It began by constructing an ideal or optimum barrier system for Western Europe that represented "all the barriers desired by a corps commander"[76] and concluded that this system would require unreasonable amounts of materiel and manpower, especially in laying minefields: "U.S. mine warfare doctrine, materiel, and techniques are not compatible with U.S. Army requirements now or in 1965–1970."[77] In conclusion, the study recommended extensive research and development into new mines and

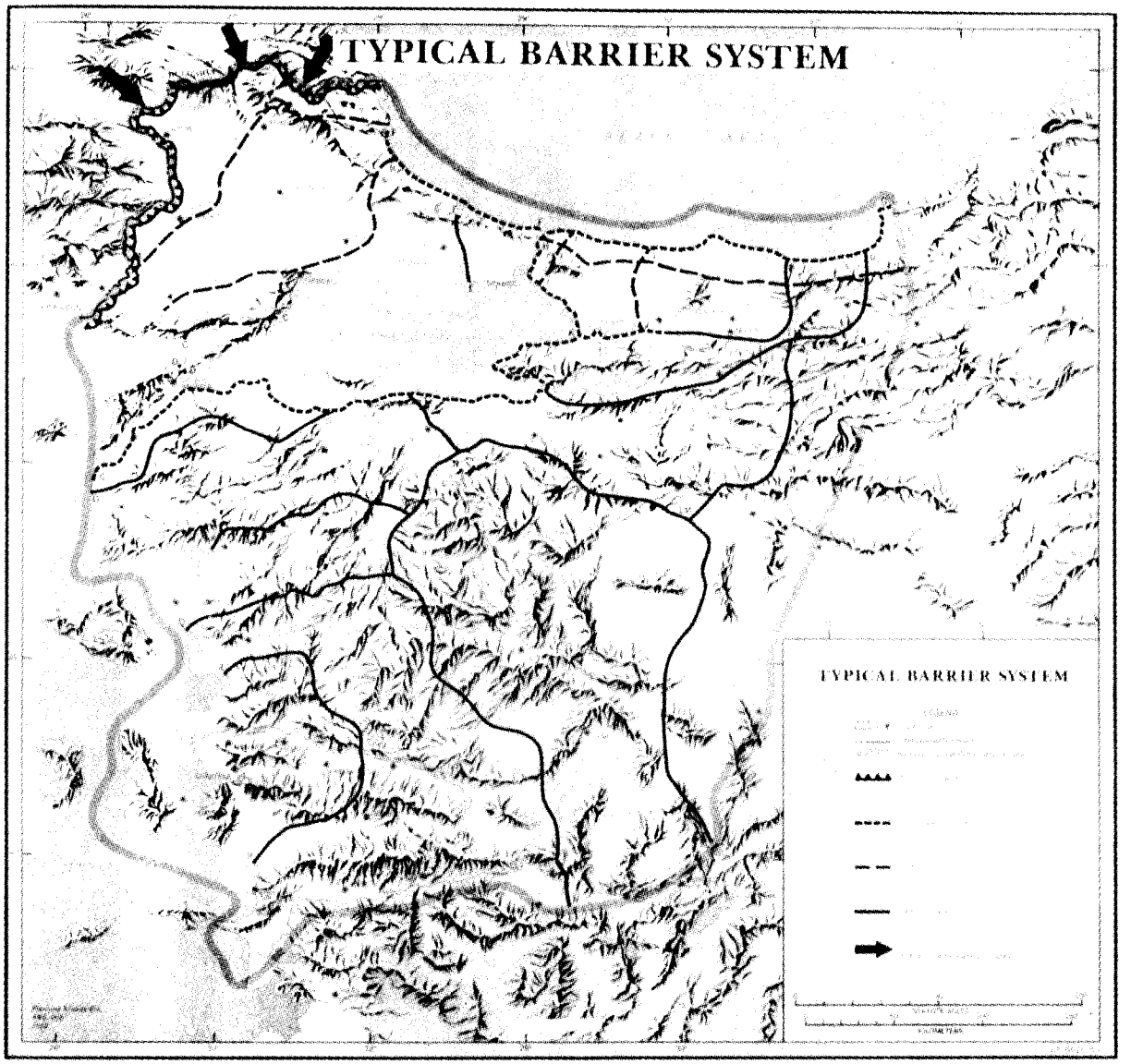

Figure 16

mine-laying equipment. Even though much of American barrier and denial doctrine and planning grew out of PSD's own work, it still strove to keep this planning realistic and reasonable.

Although the Eisenhower administration's preoccupation with nuclear weapons compelled the Army to search for methods to employ them in land warfare, many in the Army also believed that the development of tactical nuclear weapons had ushered in a new age of warfare. Lacking an opportunity to test the new weapons in actual combat, the Army turned to study and analysis for clues to their usefulness and limitations, and PSD sought to provide answers to some of the many questions that surrounded the new weapons. Studies of battlefield nuclear weapons bridged the gap between the division's work on strategic nuclear weapons and Engineer bar-

rier and denial planning. This intersection of PSD study areas led to two more decades of work on tactical nuclear weapons, especially ADMs, and barrier planning.

* * *

Both barrier and denial studies and the tactical nuclear weapons studies continued the work that the Strategic Planning Section had begun in 1950, and both were related to Engineer logistics, which had been the foundation of the organization since its formation in 1943. Although the nuclear work might have stolen some of the spotlight during the Eisenhower administration, PSD was still deeply involved in the types of Engineer logistics planning that had originated in the late 1940s and early 1950s, including the Department of the Army Strategic Logistic Studies and Engineer Functional Components System (EFCS). In 1952 the DA-SLs became an integral part of a new and more structured planning procedure for the entire Department of Defense.[78] Until 1952, joint military planning procedures had been neither well coordinated nor well structured, and in order to rectify these problems, the Joint Chiefs of Staff instituted a new procedure with many aspects still used at present. Overall planning was divided into three categories: short-, medium-, and long-range planning. For the medium-range period, three to five years in the future, the JCS drew up the Joint Strategic Objectives Plan (JSOP), which had an Army counterpart entitled the Army Strategic Objectives Plan (ASOP). The ASOP specified the campaign plans for various likely contingencies, and the DA-SLs and their technical services annexes were drawn up to support these plans. Now the DA-SLs were more than just logistics feasibility studies:

> These studies are used for (a) forecasting engineer troop and Class IV supply requirements, (b) justifying Army budgets, (c) providing guidance to research and development, (d) making feasibility tests of proposed strategic and operational plans, (e) developing broad logistic planning factors, (f) assisting in preparation and review of Theater Base Development Plans and reviewing [Tables of Organization and Equipment].[79]

During the Eisenhower years, PSD drew up 11 Engineer annexes for DA-SLs, and these continued to be thick, detailed, and difficult-to-prepare documents.[80] In addition, equivalent documents were prepared for the short-range plans, which were a part of the Army Strategic Capabilities Plan (ASCP).[81]

Because these logistics plans involved so much laborious manual calculation, attempts to use the relatively new computers in preparing them were perhaps inevitable. Not only was the manual system time-consuming, but it was also inflexible. The basic assumptions and planning factors in a DA-SL were set early in the planning process, and if unexpected contingen-

cies appeared later in the process, these new factors could necessitate drastic changes that were almost impossible to do manually.[82] The Deputy Chief of Staff for Logistics (DCSLOG) began exploring computerized gaming procedures for preparing logistics plans, and in 1961 PSD prepared a lengthy dossier on the exact procedures and organization used in preparing DA-SLs so that this process could be transferred to computers.[83] After 1961, PSD prepared no more DA-SLs, as DCSLOG and other agencies struggled to develop computer programs to replace the older manual procedures. The experience that PSD had gained in preparing DA-SLs would later be used in a new approach called Force Planning Guides.[84]

Although preparing DA-SLs was still a long and involved task, the gradual implementation of the Engineer Functional Components System had simplified some of the work. Begun in 1951, the EFCS was primarily a planning tool to expedite and standardize the construction of facilities in a theater of operations and to provide readily available bills of materials for this construction: "The EFCS is simply an attempt to describe the possible wartime Engineer tasks in terms of the materiel and manpower required for their execution; it is a 'Sears Roebuck' catalog of Engineer operations in the theater."[85] During the 1950s, PSD supervised the preparation of "type designs and engineering drawings for a variety of structures (such as mess halls) and services (such as electrical or sewage systems)."[86] Private architect-engineers drew up the detailed designs and the accompanying bills of materials, and by the end of the decade there were designs for 13 major categories of Engineer construction tasks, such as hospitals, administration buildings, POW stockades, sewage installations, and troop camps as well as more than 1,000 other miscellaneous facilities.[87] By 1960 three manuals had been published. The first, TM-301, contained introductory tables of the materiel, its weight, and the manpower required to construct the facilities in the EFCS. The second, TM 5-302, furnished "general construction drawings, special and standard construction details and simplified bills of materials for all types of construction" included in the EFCS.[88] The third, TM 5-303, contained the complete bills of materials for all facilities. For each facility in the EFCS, there were six standards of construction ranging from the most primitive to the permanent. Although the original plans called for each facility to be designed for three climate zones—temperate, tropical, and frigid—by 1961 facilities had been designed for only the temperate zone.[89] In the future, PSD hoped to extend the list of facilities, include facilities for the tropical and frigid zones, and expand the system to include more combat area tasks, because most designs were for the rear support areas.[90] Although the EFCS was far from complete by 1961, the division had expended a great deal of effort and had made substantial progress on the system.

Finally, PSD prepared a number of studies that did not fit easily into any of the categories that have been discussed. One such study illustrates a

kind of PSD work that did not always appear in a formal publication. Although these staff action or "quick-reaction" studies often did not appear in the *Bibliography*, they could require a great deal of effort over a short period of time. On 21 July 1958 the division received a formal request from DCSLOG asking for the most recent information on the airfields in the Middle East and their capacity to support American military operations in the area. In a little more than a week, the division compiled extensive technical information and specifications on 200 airfields in the area and evaluated their capacity to handle several types of American military aircraft. Although these sorts of data may be more readily available now, at that time they were assembled with difficulty, requiring more than 1,000 staff hours of effort, half of which were overtime.[91] Although such actions were relatively rare, they did require intensive work by a substantial number of people in the organization.

In the area of logistical studies, PSD was also called on to examine the liquid fuels handling facilities for supplying field armies in the event of war and the worldwide electrical power and heat requirements of the military for the 1959 to 1965 period.[92] The DA-SLs, the EFCS, and a scattering of other studies and quick-reaction efforts kept the PSD involved in Engineer logistics, which had been a major concern of the organization since its beginning. While the nuclear studies pushed the less dramatic logistical work into the background during the Eisenhower era, PSD and its successors always maintained a strong interest in the logistical and combat problems that confronted the Corps of Engineers.

By the end of the decade, nuclear and engineering studies were staples in the division's study repertory. But throughout its history, PSD encountered a variety of unusual issues, many of which occupied its attention for only a short period of time or appeared only sporadically. One of these atypical fields was chemical and biological weapons. In 1960 the division published three studies requested by the Army staff on the strategic value of chemical and biological weapons that the United States either already possessed or was planning to develop by 1965.[93] The studies defined the objectives of a strategic attack and evaluated the abilities of both the chemical and biological agents and their delivery systems to accomplish these objectives. While defining the objectives of an attack was possible, the division found it more difficult to find national policy guidance on the uses of chemical and biological weapons. Lacking this guidance, PSD evaluated the available or projected agents largely in terms of technical characteristics and concluded that biological weapons had much greater strategic value than chemical ones. Chemical weapons had the advantages of prompter effectiveness and greater stability, which the slower acting and vulnerable living organisms of biological warfare lacked. But chemical warfare required the delivery of a full effective dose on the target while biological weapons, which would reproduce, could be delivered in smaller and more manageable

quantities. Because a strategic attack would call for the delivery of such huge quantities of a chemical agent, the study concluded that biological weapons had greater strategic value.[94]

Although biological weapons were theoretically more useful, the division discovered that the United States did not have the capability of using either weapon strategically in the early 1960s. An examination of the available agents, the facilities for producing them, and the means of delivering them revealed that "by 1965 we will still have no net strategic capability."[95] A disturbing byproduct of the study's investigation of America's offensive capabilities was the discovery that the United States also had no defensive capability: "With no warning system, no masks or shelters, and very slight medical preparation, our net defensive capability is zero."[96] According to Major General Bennett Lewis, a captain with PSD in 1960 and one of the analysts involved in the study, the document "got the attention of the Secretary of the Army and immediately went to Mr. McNamara" when he became Secretary of Defense in 1961.[97] McNamara ordered additional studies of chemical and biological weapons and eventually requested additional funds for research and development in the field—both of which had been recommended in the PSD study.[98] In 1963 the division completed a similar study for the 1964 to 1970 time period. After reprinting this study in the spring of 1964, PSD ended its work in chemical and biological warfare.[99] The division's pessimistic appraisals of American offensive and defensive strategic capabilities became one factor in the gradual disenchantment with chemical and biological weapons during the 1960s and early 1970s. In 1972 the organization would return to the subject of tactical chemical weapons in its assessment of herbicide effectiveness in South Vietnam, but these brief forays into the field did not lead to a major involvement in the subject.

* * *

The two terms of the Eisenhower administration from 1953 to 1961 were a dynamic period of PSD's history. Almost by accident, the organization had plunged into one of the critical areas of the Eisenhower military policy—strategic nuclear weapons. Because the atomic and particularly the hydrogen bombs were new weapons, a great deal of controversy had arisen over how and where to use them if war broke out again. PSD analysts held consistently to the counterforce policy of restraint until a new weapon—the ICBM—and the dilemmas of the counterforce doctrine led them toward the McNamara strategy of mutual assured destruction (MAD). In spite of the fact that MAD is now under attack, the process of its development was a fundamentally important stage in the history of nuclear weapons. The interaction of both technology and doctrine was a complex phenomenon, and

the result of this debate over nuclear weapons was neither inevitable nor self-evident.

The other issues that PSD tackled during the Eisenhower years might not have always been as dramatic as strategic arms, but the approach taken to these subjects was similar. If the study called for the laborious calculation of the requirements for short-range missiles or barbed wire, nuclear explosives or electrical generators, Engineer troops for a projected campaign or hospital tents, the division compiled its estimate and explained how it had arrived at its figures. Whenever the topic called for a judgment or for analysis, as was most often the case, PSD provided it without hesitating to criticize accepted doctrines, procedures, or policy. The division's work must have angered more people than just General Twining. For some analysts, particularly those involved in the strategic nuclear work, the 1950s was one of the most demanding, yet most exciting, periods in the organization's history.

Notes for Chapter III

1. Samuel P. Huntington, *The Common Defense: Strategic Programs in National Politics* (New York: Columbia Univ. Press, 1961), p. 20.

2. Ibid., pp. 64–70.

3. Michael Mandelbaum, *The Nuclear Question: The United States and Nuclear Weapons, 1946–1976* (New York: Cambridge Univ. Press, 1979), pp. 49–52; and Jerome H. Kahan, *Security in the Nuclear Age: Developing U.S. Strategic Arms Policy* (Washington, DC: Brookings Institution, 1975), pp. 9–17.

4. Huntington, *The Common Defense*, p. 413.

5. Ibid.

6. Robert W. Coakley, "The Army Since Unification: An Old Institution in a New Environment," in Paul R. Schratz, ed., *Evolution of the American Military Establishment Since World War II* (Lexington, VA: George C. Marshall Research Foundation, 1977), pp. 39–44. This topic will be discussed again in chapter IV.

7. John P. Rose, *The Evolution of U.S. Army Nuclear Doctrine, 1945–1980* (Boulder, CO: Westview Press, 1980), pp. 55–75; and Robert A. Doughty, *The Evolution of U.S. Army Tactical Doctrine, 1946–1976*, Leavenworth Papers, no. 1 (Fort Leavenworth, KS: Combat Studies Institute, 1979), pp. 12–19.

8. Interview with John J. Taylor, Washington, DC, 18 July 1980. Similar remarks were made by Maj. Gen. Thomas H. Lipscomb, USA (Ret.), who was the officer in OCE who supervised the Planning Studies Division (PSD) in the late 1950s. Interview with Gen. Lipscomb, Haddonfield, NJ, 28 May 1981.

9. Interview with Maj. Gen. David S. Parker, USA (Ret.), San Francisco, CA, 10 Nov. 1980. See also the interview with Gen. Lipscomb.

10. Interview with Gen. Parker.

11. Ibid. Col. Warren S. Everett, USA (Ret.), made similar remarks in an interview on 19 February 1981 in Grand Rapids, MI.

12. ESC, *Target Selection Criteria for Very High Yield Weapons*, no. 1 (Dec. 1955), p. 2.

13. Ibid., p. 4.

14. Ibid.

15. Ibid.

16. Ibid.

17. Walter S. Poole, *The History of the Joint Chiefs of Staff: The Joint Chiefs and National Policy* (Washington, DC: Historical Division, JCS, 1979), IV: 144; David Alan Rosenberg, " 'A Smoking Radiating Ruin at the End of Two Hours,' Documents on American Plans for Nuclear War with the Soviet Union," *International Security* 6 (Winter 1981–1982): 9 and 30; and Henry S. Rowen, "The Evolution of Strategic Nuclear Doctrine," in Laurence Martin, ed., *Strategic Thought in the Nuclear Age* (Baltimore, MD: Johns Hopkins Univ. Press, 1979), p. 133.

18. ESC, *Briefing: A Sensible Basis for Programming Atomic Weapons*, no. 32 (Feb. 1958), p. 1.

19. ESC, *Summary Briefing on the Analysis of Atomic Annexes*, no. 35 (Apr. 1959).

20. Ibid., p. 11.

21. Interview with Gen. Parker.

22. Interview with Mr. Taylor. Maj. Gen. Bennett L. Lewis, USA (Ret.), made similar comments in an interview on 19 May 1981 in Washington, DC.

23. Rowen, "The Evolution of Strategic Nuclear Doctrine," pp. 133–135; and Mark D. Mariska, "The Single Integrated Operational Plan," *Military Review* 52 (Mar. 1972), pp. 32–39.

24. ESC, *Target Selection Criteria for Very High Yield Weapons*, p. 1.

25. Interview with Mr. Taylor.

26. Interview with Col. Everett.

27. Interview with Mr. Taylor.

28. Ibid.

29. ESC, *Analysis of Atomic Annex Standardization Guide for JCS Designated Commanders*, no. 18 (Jan. 1957), Tab A, p. 10.

30. Ibid., Tab A, p. 8.

31. ESC, *Residual Radiation as a Primary Means of Deterring General War 1961–1965*, no. 11 (Apr. 1957).

32. Ibid., p. 4.

33. Ibid., p. 9.

34. Ibid.

35. Ibid., p. 25.

36. ESC, *Briefing: Requirements for U.S. Long-Range Retaliatory Forces*, no. 30 (Nov. 1958), p. 17A.

37. Ibid.

38. Ibid.

39. Ibid.

40. Interview with Gen. Parker.

41. ESC, *Briefing: Requirements for U.S. Long-Range Retaliatory Forces*, p. 62.

42. Ibid., p. 68. This was published in November 1958. By the end of December it had been briefed 16 times to various members and groups of the Army and Joint staffs. On 30 December, Col. Parker presented it to Gordon Gray, Special Assistant to the President for National Security Affairs, Weekly Items of Interest, 1958, Headquarters, Strategic Planning Group (SPG), Army Map Service (AMS), USACE, RG 338, National Personnel Records Center (NPRC), St. Louis, MO.

43. Interview with Gen. Parker.

44. ESC, *Comparison of Service Submissions for a JCS Target System*, no. 59 (Jan. 1960), p. 5.

45. Ibid.

46. ESC, *Briefing: The ICBM Duel*, no. 60 (Aug. 1960).

47. Interview with Gen. Parker.

48. ESC, *Briefing: The ICBM Duel*, p. 53.

49. Ibid., p. 55.

50. John J. Taylor, "Some Related Conclusions," attachment to ESC, *Comparison of Service Submissions*. The paragraphs of the original have been slightly rearranged.

51. Interview with Gen. Parker.

52. ESC, *Strategic Value of the Greenland Icecap*, nos. 50 and 51 (Mar. 1960). See also the interviews with Gen. Parker and Gen. Lewis. For a related study, see ESC, *Land Operations in the Arctic*, no. 54 (June 1960).

53. ESC, *Strategic Value of the Greenland Icecap*, I: v.

54. Ibid., I: 2–5.

55. Ibid., I: H–3.

56. Ibid., I: 16.

57. Ibid., I: 17.

58. Huntington, *The Common Defense,* p. 80; Mandelbaum, *The Nuclear Question*, pp. 100–105; William Van Cleave and S.T. Cohen, *Tactical Nuclear Weapons: An Examination of the Issues* (New York: Crane, Russak, 1978), p. 4; and Michael H. Armacost, *The Politics of Weapons Innovation: The Thor-Jupiter Controversy* (New York: Columbia Univ. Press, 1969).

59. Doughty, *Evolution of U.S. Army Tactical Doctrine*, pp. 12–19; and Rose, *Evolution of U.S. Army Nuclear Doctrine*, pp. 55–75.

60. ESC, *Tactical Atomic Weapons Requirements for Support of Allied Ground Forces 1960–1965*, no. 4 (July 1956), Tab B, p. 1.

61. ESC, *An Analysis and Evaluation of Atomic Weapons Play Exercise SAGEBRUSH*, no. 10 (May 1956), Tab A, p. 2.

62. Ibid., pp. 1–4.

63. Ibid., p. 4.

64. Gen. Maxwell Taylor, "Foreword," included in ibid.

65. ESC, *Tactical Atomic Weapons Requirements*; ESC, *Requirements for Family of Medium Range (15–1500 Mi.) Surface to Surface Missiles*, no. 5 (Apr. 1956); ESC, *Launching Facilities Requirements for Medium Range (15–1500 Mi.) Surface to Surface Missiles*, no. 6 (June 1956); and ESC, *Department of the Army Missile Deployment Analysis*, no. 27 (Dec. 1958).

66. Interview with Gen. Parker.

67. ESC, *A Mobile Base System for Surface-to-Surface Missiles in Europe*, no. 39 (Jan. 1959); and ESC, *A Mobile Base System for Surface-to-Surface Missiles in Europe, Supplement One*, no. 38 (Mar. 1959).

68. ESC, *Atomic Demolition Munitions Requirements*, Unnumbered (Mar. 1956), p. 20.

69. Ibid.

70. The best general evaluation of the advantages and disadvantages of ADMs is included in ESC, *General Concepts of Engineer Barrier and Denial Planning*, no. 22 (Sept. 1958), pp. 67–69.

71. ESC, *Atomic Demolition Munitions Requirements*; and interview with Robert B. Bockting, Washington, DC, 5 Feb. 1981.

72. ESC, *General Concepts of Engineer Barrier and Denial Planning*, p. 1.

73. ESC, *Qualitative and Quantitative ADM Requirements*, no. 20 (Feb. 1958), pp. 1–6.

74. ESC, *General Concepts of Engineer Barrier and Denial Planning*, p. 6.

75. Ibid.

76. ESC, *Logistic and Development Implications of Corps Barrier Operations—Western Europe 1965–1970*, no. 40 (Sept. 1959), p. 6; and interview with Leon Albin, Washington, DC, 9 Feb. 1981. Mr. Albin is a former ESC analyst.

77. ESC, *Corps Barrier Operations*, p. 6.

78. Poole, *The Joint Chiefs and National Policy*, IV: 175–177.

79. Functional Statements, 4 Feb. 1955, ESC Historical Files.

80. The DA-SL studies are numbers 23–26, 43–46, and 55–57 in the ESC *Bibliography*.

81. Interviews with Mr. Albin and Col. Everett.

82. Lazarus Todd, "War Gaming and Simulations in Military Planning," ODCSLOG, Plans Division, May 1962; and Memorandum for Record, 27 Oct. 1959. Subject: Computerization of DA-SL Engineer Annex Preparation, SPG, AMS, RG 338, NPRC.

83. ESC, *Dossier of the Preparation of Engineer Annexes to DA-SLs*, Unnumbered (1961).

84. Todd, "War Gaming and Simulations in Military Planning"; and interview with Mr. Bockting.

85. USARPAC briefing on the Engineer Functional Components System (EFCS), 1 Dec. 1959, SPG, AMS, RG 338, NPRC.

86. Richard W. O'Neal, "Slipshod Slipstick or Functional Components," *Army* 8 (Aug. 1957): 48.

87. Interview with Col. Everett; and USARPAC briefing on EFCS, SPG, AMS, RG 338, NPRC.

88. O'Neal, "Slipshod Slipstick or Functional Components," p. 50.

89. USARPAC briefing on EFCS, SPG, AMS, RG 338, NPRC.

90. Ibid.

91. ESC, *Department of the Army Middle East Airfield Study*, no. 29 (July 1958). Other staff action studies can be found in the Weekly Items of Interest for 1957 and 1958, SPG, AMS, RG 338, NPRC.

92. ESC, *A Study of the Characteristics of Theater of Operations Liquid Fuels Handling Facilities for the Period 1960–1970*, no. 36 (May 1959); and ESC, *Department of the Army Worldwide Military Electrical Power and Heat Requirements*, no. 42 (Apr. 1959).

93. Interview with Gen. Lewis. The studies are ESC, *Appraisal of Strategic Biological and Chemical Weapons, 1960–1965*, no. 61 (Oct. 1960); ESC, *Appraisal of Biological and Chemical Weapons, 1960–1965*, no. 62 (Nov. 1960); and ESC, *Appraisal of Biological and Chemical Weapons, 1960–1965*, no. 63 (Dec. 1960).

94. Ibid., p. 6.

95. Ibid., p. 25.

96. Ibid., p. 26.

97. Interview with Gen. Lewis.

98. Ibid.

99. ESC, *Strategic Roles for Chemical and Biological Weapons*, no. 89 (Nov. 1963); and ESC, *Strategic Roles for Chemical and Biological Weapons*, no. 107 (Mar. 1964).

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